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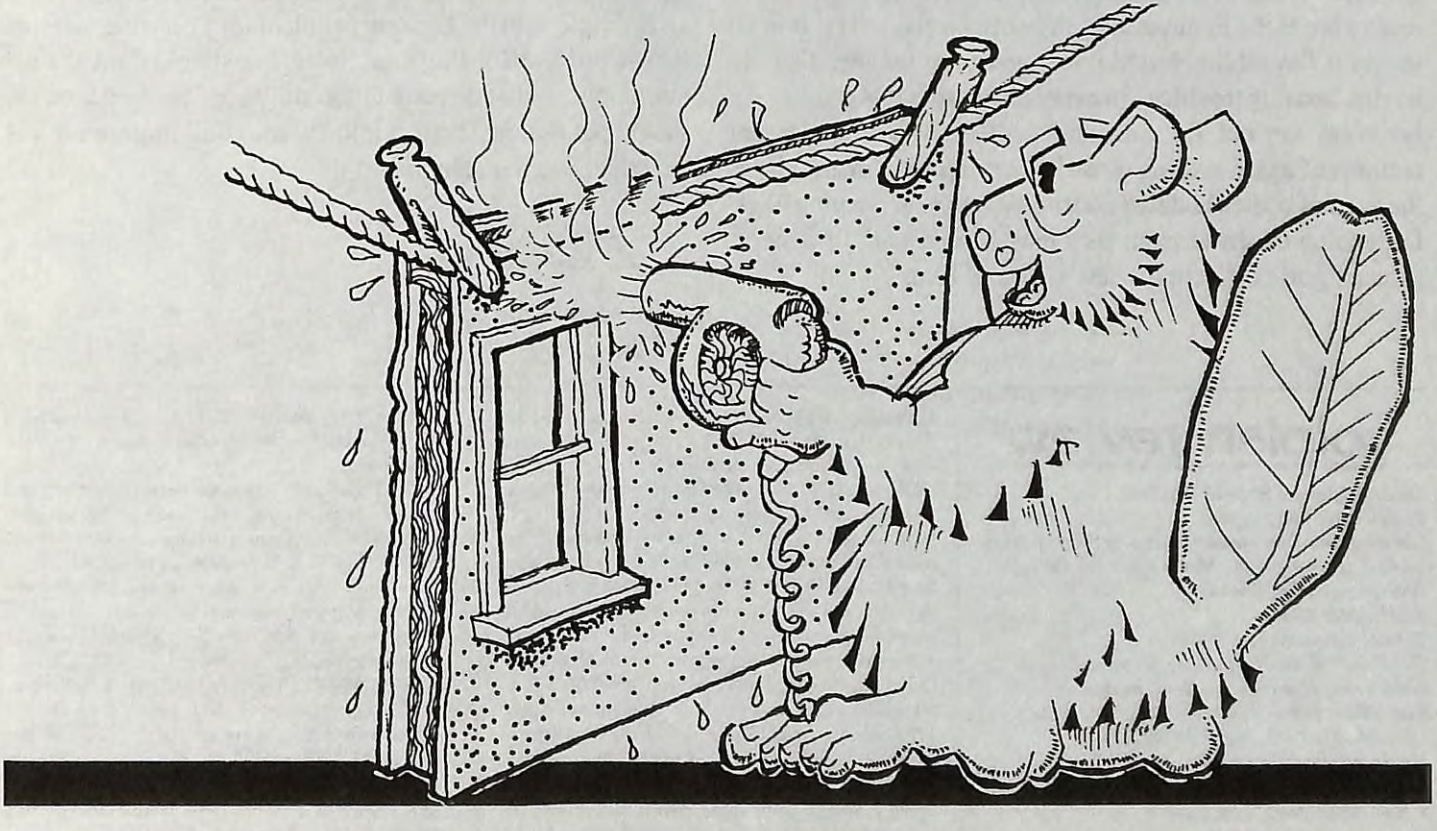
Do Walls Dry Once They Get Wet?



From the Editor . . .

I was going through the mile high pile in my in-basket, trying to catch up, when a picture in *Azure*, a design and architecture magazine, caught my attention. It was a picture of a simple little house designed by a Toronto architect for a shantytown.

Slums and shantytowns seem to be the landmark of many cities around the world, especially in the less developed poorer nations. In the past half-century they have virtually disappeared from the industrialized world, notably Western Europe and especially the G8 nations. So it came as a shock to read the fine print saying that this 10 x 20-foot house was built to comply with the Ontario Building Code. It was built off-site and was moved to a shantytown in Toronto. It seems the shantytown has sprung up because of the number of homeless people who have no other place to call home.

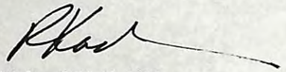
Homelessness, slums, and shantytowns existed in Canada in the past, just as they did everywhere else, but disappeared as our country rebuilt after the Second World War. As a community we found the will and the means to deal with the disadvantaged, the poor, the elderly, and those unable to look after themselves.

It is disturbing to see an increase in homelessness in Canada. While every society has a few members who do not seem able to fit in anywhere and stay on the street, it is no longer a few adults, but children and even families that are having housing troubles. In every city across this country the homeless are not far from sight. One of the unpleasant features of a late evening or early morning walk in any city is the sight of bodies huddled under blankets or in sleeping bags. Depending on the season, they may be in a park or over an exhaust grate collecting a few BTUs of heat.

It is a sad commentary on how our community values have moved backward. Today we tolerate homelessness again. It seems as if we've turned our backs on the disadvantaged, the poor, the elderly, and those unable to look after themselves. The increasing numbers of homeless can be traced directly to public policies that have removed support from the most disadvantaged. And many wholeheartedly support these policies.

I raise this issue here because, as builders, we generally focus only on the well-to-do middle and upper classes. There are occasional efforts such as in Saskatoon, where homebuilders are actively involved in an effort to put homes within the reach of low-income people. I am sure there are pockets of activity in other areas, too. However, such efforts seem to be the exception. Despite all the talk I hear about affordable housing, there seems to be little creative energy devoted by the industry to deal with real access and affordability.

Reducing red tape or development levies may lower costs, but does nothing for those who in ever-greater numbers are sleeping on the street. As an ethical human being, I find the current situation very disturbing. Solutions may not be quick or easy. We should be devoting creative energy to try and grapple with the housing problem for everyone, not just those who can afford big mortgages. We should fight against those policies that directly target the poor. As builders, we should put an honest effort into "home" building for all, not the select few that can afford it.



Richard Kadulski,
Editor

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Do Walls Dry Once They Get Wet?

Moisture is the biggest source of problems and premature failure in construction. Moisture problems are not limited to any geographical area, climate zone or construction type. It is only the type and severity of the problem that will vary when mistakes are made.

We can do a lot of analysis, but how certain can we be that calculations done on paper are accurate? Much of the knowledge we have has been gained in the field by trial and error over many years. Recently, gaps in building performance research have been identified as a result of the performance failure of building envelopes in coastal British Columbia. This has led to much research activity, which is improving our understanding of how buildings work.

One knowledge gap identified was test evidence of the ability of different wall systems to dry once they were wetted. If an insulated wall gets wet, will it dry? Can it dry?

In 1998 CMHC published the ***Best Practice Guide for Wood-Frame Envelopes in the Coastal Climate of British Columbia***. It emphasized that walls have to manage moisture by a combination of deflection, drainage, drying and durability. Deflection, drainage and durability have been studied, but little attention has been given to the effect of wall design on drying rates. Adoption of the practices recommended in the Guide by the building industry is expected to result in a near total elimination of moisture ingress into walls. However, small defects or the deterioration of a building's deflection and drainage system could still cause some moisture to accumulate in a wall if drying does not occur. Thus, there is a need to know to what extent drying can contribute to the overall moisture management plan for wall designs.

One research project recently completed was a laboratory test to determine how long it takes for wet walls to dry. The test compared how long it takes for walls using different construction details to dry.

Twelve test wall panels were mounted into a climate-conditioned test chamber for up to three months to measure the drying rate of each panel. At the start of the test, each panel was soaked in a shallow tank of water to wet the studs and plates (the sheathing did not come into direct contact with the water). The starting moisture content of the framing lumber was 25-30% by weight and the sheathing was 20-25%.

The laboratory environment simulated typical Vancouver winter climate conditions: 5° C (41° F) at 70% RH. The indoor condition was 20° C (68° F) with an average RH of 40%. The wall assemblies were tested concurrently so the drying forces were identical for all panels. The panels were not subjected to air movements representative of wind loads and gusts, but an air current of 5m/s was directed at all the test panels to induce a 1-to-5 Pa pressure differential between the bottom and the top of the panel.

Lumber was sorted carefully to match the natural variability of wetting and drying of each piece of wood used so the drying rates could only be attributed to their design. The sheathing was either 11.5 mm oriented strand board (OSB) or 12.5 mm plywood applied horizontally. A 3-mm horizontal gap was included at panel mid-height. All the OSB or plywood was drawn from the same bundle sourced from a single mill.

All the panels were insulated with standard R-14 (RSI 2.45) friction fit batt insulation. Polyethylene was applied on the interior surface of the framing to ensure that the moisture only went in an outward direction. The sheathing membranes were either two layers 30-minute asphalt building paper or one layer spun-bonded polyolefin. The rainscreen cavity between the sheathing membrane and the cladding was either 19 or 10 mm deep and defined by treated plywood furring strips applied vertically at each stud. The vent area was created by a standard stucco J mould and a base flashing of pre-painted 28-gauge steel.

Ten panels had stucco cladding and two had cedar channel siding. The stucco was standard three-coat ⅝" (15 mm) thick sand cement lime, applied as required by the National Building Code of Canada.

Two tests were done. In one the wall assemblies were kept in complete darkness in the test chamber. The second test included a solar effect. Lights provided an evenly distributed solar load on the test

panels for eight hours in 24. The solar loads simulated the conditions typically found on a north wall in Vancouver during the winter. Light intensity was increased from 0 to 120 watts/m² during the first three hours, kept at 120 watts/m² for two hours, and then gradually dimmed to 0 watts/m² over the next three hours. The panels were in total darkness for 16 hours. This cycle was repeated for the 82 days of the test.

Do wall panels dry?

Drying occurred in all panels. The average moisture content in the studs at the start was 29% and after 62 days it was 12%. However, the drying was not uniform and no test panels dried completely, so that all elements were less than 19%.

While the framing, on average, dried to less than 19% in 20 days, the OSB and the plywood sheathing generally stayed above 19%. Some redistribution of moisture took place, with moisture moving from the framing to the sheathing in the first 20 days, followed by very slow drying for the next 62 days. However, there was very little change in the moisture content of the sheathing. The plywood-sheathed panel with no rain screen cavity had an increase in moisture and ended the test with an average sheathing moisture content of 42%.

Do some walls panels dry faster than others?

Panels with cavities dried faster than similar panels without cavities, and plywood sheathing dried faster than OSB sheathing.

The sheathing membrane, whether building paper or spun-bonded polyolefin, did not make any substantial difference in the drying rates.

Panels with top and bottom vented cavities dried faster than similar panels with bottom-only vented cavities.

Panels with wood siding dried faster than stucco cladding in the first test, but this was reversed in the second test with the solar effect.

In both tests the plywood sheathing absorbed more moisture than OSB, starting at a higher initial moisture content.

Does the drainage cavity width affect drying?

Three cavity widths (the air space between the cladding and the sheathing membrane) were tested: no cavity, ⅜" (10 mm) and ¾" (19 mm). Cavity width does appear to be an important factor in the drying rate. The larger the cavity width, the faster the drying.

What is the effect of solar energy on the drying rate?

Drying was not significantly affected by the solar load, although the final moisture content in the sheathing varied between the two tests. If solar energy was ignored, the moisture content in both the OSB and plywood sheathing did not change. In the second test with the solar effect, the moisture content in the OSB in panels with vented cavities increased an average of 11% while the moisture in the plywood-sheathed panels with vented cavities dropped an average of 7.5%.

This suggests that moisture was moving from the framing into the plywood and OSB sheathing. With the solar effect, moisture was not leaving the OSB faster than it was entering. In the plywood-sheathed panels with vented cavities, moisture was leaving the plywood faster than it was entering. This suggests that cavity venting has a substantial effect on the drying of plywood sheathed walls but less on drying of OSB-sheathed walls.

Do calculation tools predict moisture movement accurately? Does the calculated permeance of the assembly match the effective permeance?

Permeance is an indicator of how easily water vapour can diffuse through a material. The higher the permeance, the greater the diffusion and presumably, under the right conditions, the more moisture will be able to move through. The permeance of 6 mil polyethylene is 3.4 ng/Pa.sec², latex vapour barrier paint 26, gypsum board 2860, and spun-bonded polyolefin 3646. The building code defines anything less than 60 ng/Pa.sec² as a vapour barrier.

The calculated permeance of the test panels (based on published data for the materials used) ranged from 246 ng/Pa.sec² to 398 ng/Pa.sec.². Although more analysis is required, the observed results show there is a significant difference in practice. The plywood-sheathed panels had a much higher effective permeance than the OSB-sheathed panels, this may in part be due to greater quantity of adhesives in the OSB.

The panels with vented cavities generally had a higher effective permeance than the unvented panels. The panels with top and bottom vented cavities showed the greatest effective permeance due to the solar effect. This corresponds to a known property of wood, which is that it becomes more permeable as the moisture content increases. In a very small way it is a self-correcting mechanism, giving wood a limited tolerance for moisture.

What does the permeance have to do with drying? In Vancouver rainfall on a wall can amount to more than 400 kg/m² per year. If that moisture were to get into the envelope, less than 1% of that moisture could be removed by drying because of the effective permeance of the assemblies observed in this study. That means 99% of the moisture has to be managed by deflection and drainage.

Study Limitations

It is important to recognize that this research was a limited laboratory exercise. It does not match field conditions because the wetting process was not the same as the wetting of walls in a real building and the panels were not re-wetted during the test. Weather conditions, including air movements such as wind loads, temperature, rainfall and solar radiation are highly variable. As well, the test panels were representative of the field portion of a typical wall. They did not include any envelope penetrations (such as windows, vents, balconies, etc.).

These tests looked at worst case scenarios, deliberately soaking the construction. The results show that good design details and proper construction is very important. You cannot count on drying to overcome fundamental problems.

- ☞No test panels dried completely - all had portions with a moisture content of more than 19% at the end of the test.
- ☞Rainscreen panels dried faster than those without a cavity.
- ☞Neither building paper nor spun-bonded polyolefin sheathing membrane made any difference on the drying rates.
- ☞Plywood sheathing absorbed more moisture than OSB but was also more vapour permeable

However, the results of this study do show that rainscreen cavities can improve deflection (by reducing pressure differentials) and drainage, which reduce the wetting load.

For drying to be effective, builders and designers should use rainscreens with a minimum ¾" (10 mm) cavity width, with venting and drainage at the bottom and a small amount of venting at the top of cavities.

Consider using vapour-permeable flashings around windows and doors where higher concentrations of lumber can store larger quantities of lumber. ☼

The Envelope Drying Rates Analysis (EDRA) Study was conducted as part of the program of the Building Envelope Research Consortium (BERC), an industry/government consortium led by Canada Mortgage and Housing Corporation (CMHC), British Columbia Housing Management Commission (BCHMC) and the Homeowner Protection Office (HPO) of British Columbia.

Drying of Stucco-Clad Walls

An earlier study measured the drying of stucco-clad walls with a rainscreen. The stud cavities of seven stucco-clad wall panels were wetted and their drying measured. Five panels were wood framed and two were steel framed.

The wood framed walls had plywood sheathing installed horizontally with a 3-mm gap between panels. Water was introduced at a rate of 1 litre per day for four days into the stud space of each panel and evenly distributed against the inside of the sheathing from the top. After wetting, the test conditions were maintained for 150 days.

The warm side was kept between 19° C and 25° C, with a relative humidity between 35% and 60%. The cold side was between 5° C and 14° C, with 45% to 85% RH. There was no air pressure difference across the panels and the effects of wind and solar heating were not considered, which might influence the drying rate.

Drying was very slow. There was little difference between panels. Two inches (50 mm) above the bottom plate the moisture content in the studs increased to about 20% for the first 30-40 days, after which the studs dried slowly but never reaching the initial 10%. The moisture content in the wood sheathing two inches (50 mm) above the bottom plate increased to more than 80% in 2 to 25 days, and remained there in all cases for 75 days or more. Moisture movement or redistribution to other materials within the stud cavity is limited -

where water enters a wall is where it stays, so water must not be permitted to enter into the stud cavity.

When the test was stopped and the wall panels opened, dark staining was observed at the bottom of all wood wall panels, extending 150 mm up from the bottom plate. The water that had run down the sheathing had soaked into the wood at the bottom of the panels and was not redistributed by diffusion to other parts of the assembly to any significant extent.

This test was done before the EDRA lab test. Results showed that drying was slow for all panels. Once moisture enters the stud cavity, the drying process is very slow, so the rain screen approach does not automatically improve the drying potential.

The results show that effective water management strategies in exterior wall assemblies are very important. Walls that have cavities with drainage, venting, and appropriate detailing of penetrations are more effective at keeping rainwater out of stud cavities of walls than face-sealed walls without cavities. ☼

Annotated Bibliography of the Building Envelope

This bibliography contains a list of more than 170 reference materials concerning the design, construction and maintenance of the building envelope, including references specific to the coastal climate. It is for the use of designers, including architects and engineers, contractors, material manufacturers, strata councils, property managers, owners, and others involved with residential construction. Although it is specifically targeted at British Columbia, anyone in other areas looking for building envelope information will find the bibliography useful.

The bibliography focuses on recent documents, from 1985 to today. It builds on an earlier Annotated Bibliography on the Rain Screen Principle published in 1985 by the Division of Building Research of the National Research Council of Canada. Although major articles and texts have been included in this bibliography, its author acknowledges that there are many more publications on the topic.

The bibliography is easy to follow, and includes links to other information sources. It is accessible on the Internet at *http://hpo.bc.ca* (Look under the What's New tab).

An especially useful feature for local users is information on how to access the books, publications or articles. The references indicate where the publication is available in major public or educational libraries in BC. The power of the Internet is taken advantage of here, as direct links are provided to libraries and their catalogues.

The references have been subdivided into the following general categories:

- General References: Building Science, Building Envelope, Durability
- Construction Types: Materials and Methods
- Cladding Systems: Wall Cladding, Windows, Sealants
- Moisture in Walls: Water, Water Vapour, Rainscreen System
- Air Movement and Walls: Air Barriers, Wind Pressure, Ventilation
- Thermal Transfer in Walls: Insulation, Thermal Breaks
- Renovation
- References Specific to British Columbia

The document is available in HTML and PDF versions.

The Annotated Bibliography of the Building Envelope was prepared for the Homeowner Protection Office of BC by Linda Brock, a professor at the University of British Columbia School of Architecture, and was a project carried out in conjunction with the Building Envelope Research Consortium (BERC).

Linoleum: a "Green" Flooring Option

The wish to be more environmentally responsible is encouraging designers and builders to look not only at the way they build but also at the materials they use. "Sustainable" and "green" are terms that are being overused today.

To be "green" requires the use of products and designs that have the smallest impact on the environment. It means products that are durable, that are made of materials that have a low impact on the environment, and that have a low impact over their lifetime in use and in maintenance. Although it is hard to generalize, many synthetic petrochemical-based products tend to be at the "bad" end, while natural products that require minimum processing will be at the "better" end.

Linoleum is an example of a sustainable product. It was first introduced more than 150 years ago and has seen a resurgence in use since the 1980s.

Linoleum has performance benefits unlike other flooring products. It is durable, easy to repair, is inherently antimicrobial, and has low-cost maintenance. The bactericidal properties of linoleum prevent micro-organisms from multiplying. That is why linoleum is often used in medical facilities. Unlike most other floor coverings, linoleum has naturally occurring antistatic properties. Not only does this reduce the potential for electric shock, but also makes the floor easier to clean as dust and dirt will not adhere to it.

The raw ingredients essentially have not changed for 150 years, although the recipes and manufacturing techniques have. The ingredients in linoleum are linseed oil, resin, limestone, wood flour, pigments, and jute.

Linseed oil, which is obtained by pressing flax seeds, is the most important raw material for linoleum and from which its name was derived. Linseed oil and resin are oxidized and form the binder that cements all the other ingredients together. Over the years linseed oil has been used for many things, from cooking oil to providing quick relief to people suffering from colds.

Resin is tapped from pine trees. Its collection has no impact on the health of the trees. Together with the linseed oil, resin gives linoleum its strength and flexibility. Very finely ground limestone is added to the mix.

Cork flour made from the bark of the cork oak grown in Mediterranean countries is the traditional wood fibre used in linoleum. The bark is peeled every seven to ten years with no impact on the life or health of the tree. Most of the cork used is the scrap generated by the production of wine corks, thus eliminating the waste from that production process.

However, cork is not the only wood fibre used. Forbo, one of the major linoleum producers, now only uses wood flour in its flooring products because wood flour has a better ability to bind with pigments to provide long-term colour-fastness. Finely ground wood flour also provides a smoother surface, making cleaning easier. The wood flour is made from timber grown in controlled forestry zones in Europe. Every felled tree is replaced with new plants.

Vibrant colours for the flooring are created by using organic pigments with no heavy metals such as lead or calcium and pose no threat to the environment.

Jute, spun from jute plant fibres in India and Bangladesh, forms the backing. It is a natural product that has inherent strength. Not only is jute available in abundant, renewable supply, but it also provides economic export opportunities for these developing economies.

The ingredients are mixed and pressed onto the jute fabric. Long sheets of linoleum are then hung in drying rooms for about two weeks to cure and harden. Waste material is reused by feeding it back into the production process.

Linoleum is biologically degradeable. After its useful life, linoleum can be put into a land fill where it can decompose. In some areas, waste is incinerated to generate electricity. When placed into such an incinerator, linoleum products have an energy content comparable with that of coal (18.6 MJ/kg). As no toxic or corrosive gases are released, gas purification is not necessary. The amount of CO_2 released is largely compensated for by the amount of CO_2 the raw materials (flax plants, trees, and jute plants) consume during their growth. ☼

Linoleum is not to be confused with vinyl flooring, which has come to dominate the flooring market in the past half century.

It's Time to Sound the Alarm about High Capacity Exhaust Fans

by JC Haysom, PH Huelman and D Fugler

More and more high capacity exhaust fans are being used today - appliances such as downdraft cooktops that draw 600+ cfm, large range hoods that draw 400+ cfm, clothes dryers that draw 400+ cfm, etc. Unless these appliances are installed to allow for fan-supplied make-up air, they can severely depressurize modern houses. This can lead to problems with venting of combustion products, soil gas infiltration and infiltration of carbon monoxide from attached garages.

Depending on where these appliances are installed in a new building, it may be difficult for builders to comply with code requirements for fan-supplied make-up air if the appliances have not been designed with provision for interconnection.

Of more serious concern is when the owner of an existing house simply purchases and installs one of these appliances and is unaware of the problems it can create. It is unlikely that the building department would be involved in such cases. A paper reviewing the concerns with high capacity exhaust appliances and possible means of addressing them was presented at a major indoor air quality conference in California in June.

The combination of increasingly large exhaust devices installed without make-up air provisions and increasingly tight houses is bound to lead to health and life-threatening problems. If the appliance industry does not take the initiative in this area, regulatory agencies will force it to take action.

The appliance industry does not seem to be aware of the problems these devices can create in even a moderately tight house. Otherwise, they would not ignore the issue in their installation instructions and the appliances would have the ability to interconnect with supply fans. Unfortunately, current appliance standards do not help, as they only deal with energy efficiency or electrical safety, and not the appliances' impact on the rest of the house.

When installed in a new building, local building officials can apply the requirements of the building code, which mandate the provision of fan-supplied make-up air. However, it is difficult to comply with the code's requirements if the appliances have not been designed to allow for interconnection with supply fans.

The Effect of Exhaust Devices on Tight Houses

When an exhaust fan takes air out of a house (Figure 1) and there are no supply fans operating simultaneously, the air will automatically be replaced by inward leakage of outside air. The inward leakage will automatically balance the air being removed. This is true regardless how airtight or leaky the house. In a tight house, the pressure difference may simply be bigger.

An exhaust fan without a matching supply fan will always depressurize a house to some extent – even a leaky house. But any given fan will depressurize a tight house more than a leaky house. A fan with a higher capacity will depressurize a house more that a fan with a smaller capacity.

Recent research found that 36 out of 49 randomly selected new houses in various parts of Canada were tight enough that simultaneous operation of their ventilation fans, clothes dryers and range hoods (totaling less than 400 cfm of exhaust capacity in all but one case) would result in a

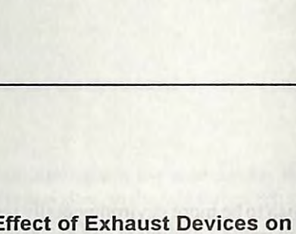

Figure 1 Exhaust-only system in a leaky house

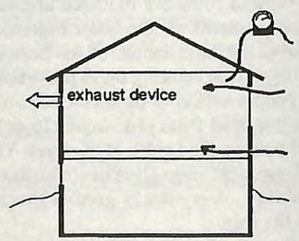

Figure 2. Exhaust-only systems in a tight house

depressurization of more than 5 Pa, the level that is generally regarded as the threshold at which problems are likely to occur. Thirteen of these houses would be depressurized to more than 10 Pa and two of these would be depressurized to more than 100 Pa if their exhaust devices were actually capable of achieving full flow at such high pressures! Eighteen of these houses would be depressurized to more than 5 Pa by operation of the clothes dryer alone.

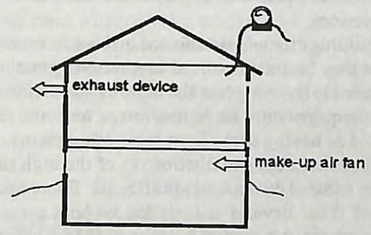

Figure 3 A balanced system

The Effect of Depressurization in Houses

In many houses depressurization does not create any problems. However, the potential for depressurization to cause problems exists if the house has any form of combustion equipment, the house is in an area where soil gas drawn into the basement by depressurization may contain radon or other pollutants, and if the house has an attached garage.

Spillage of Products of Combustion

All combustion appliances used in houses, such as furnaces, wood stoves, fireplaces, water heaters and clothes dryers must be vented to the outdoors. Some venting systems fail under very modest depressurization of the house, so some portion of the combustion gases fail to go out the vent and spill into the house.

The combustion appliances most vulnerable to depressurization-induced combustion products spillage are open fireplaces. Next are "naturally aspirating" gas and oil furnaces and water heaters, i.e., those with draft hoods (gas) or barometric dampers (oil). Newer, higher efficiency appliances such as "induced draft," "direct vent," or "high efficiency," are generally considered to be resistant to depressurization-induced back drafting, but they are not tested for the highest level of depressurization the equipment can tolerate.

Infiltration of Soil Gas

Soil can hold a wide variety of pollutants that can be harmful if they enter the house, either to the house itself or to the occupants – radon gas, volatile organic compounds, bacteria, moulds, water vapour, etc. In the winter, basements tend to be at a lower pressure than the surrounding soil due to stack effect, so even in the absence of depressurization caused by fans basements should be resistant to soil gas infiltration. Building codes specify simple provisions to deal with this, such as polyethylene under basement slabs. However, if the pressure difference between the soil and the basement is increased by high capacity exhaust fans, this may not be enough. The potential for hazardous levels of infiltration is even greater

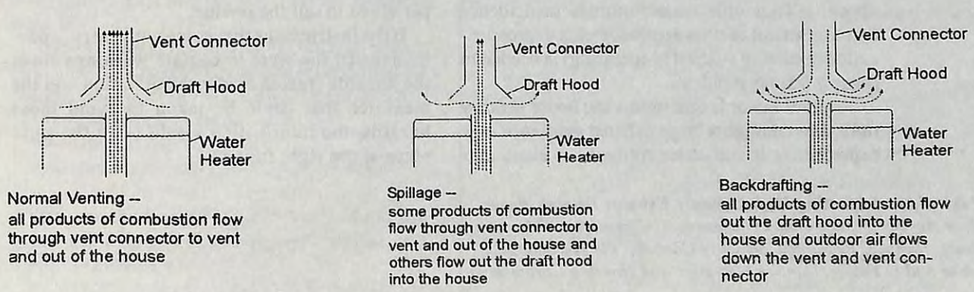
Vent Connector
Draft Hood
Water Heater
Normal Venting –
all products of combustion flow through vent connector to vent and out of the house
Vent Connector
Draft Hood
Water Heater
Spillage –
some products of combustion flow through vent connector to vent and out of the house and others flow out the draft hood into the house
Vent Connector
Draft Hood
Water Heater
Backdrafting –
all products of combustion flow out the draft hood into the house and outdoor air flows down the vent and vent connector

Figure 4. Three possible combustion venting conditions.

when big exhaust fans are retrofitted in existing houses that may not be resistant to soil gas infiltration.

Infiltration of Carbon Monoxide

The separation between an attached garage and a house must be gas tight to block the passage of air from the garage into the house, otherwise carbon monoxide and other pollutants can enter. Evidence now suggests that common walls are not very tight and are no match for the high pressure differences created when the house is depressurization by high capacity fans.

The Problems

High capacity exhaust fans are readily available and can be retrofitted in houses where they can create hazards that are health- and even life-threatening. In most cases, there is no mechanism in place to warn the occupants of the hazards being created and how to avoid them.

Even when there are such mechanisms in place, such as in the case of new houses where the building code compliance/enforcement process creates awareness of the hazards and the avoidance measures, avoiding problems can be difficult if the fan controls are not designed to allow interconnects.

Unfortunately, neither the manufacturers of the high capacity fans nor the retailers are aware of the hazards the fans can create. One increasingly sees large draft hoods advertised in home improvement store flyers without a word about depressurization or the need for make-up air.

Why do these problems have such a low profile? The spillage from most gas appliances is usually a fairly benign mixture of carbon dioxide and water vapour. It is only if the appliance is somehow out of tune that significant levels of carbon monoxide appear. Thus only an unfortunate coincidence (such as an out of tune appliance plus depressurization occurring when it is operating) is needed to cause a serious problem.

Another factor is that unless the house is fairly tight, even though a large exhaust appliance may depressurize it and cause spillage, so much outdoor air is also brought in that the spillage products are diluted to safe levels. However, as houses get tighter and exhaust appliances get bigger, we cannot continue to rely on this lucky combination.

Who Is Affected by These Problems?

Although they are generally not aware of it, the occupants of the houses where high capacity exhaust fans have been installed are obviously affected because they are exposed to hazards.

Builders are affected because, when they are unable to directly interconnect the exhaust devices with make-up air fans, they must find "work-around" solutions such as the use of current detecting devices.

Building officials are affected in those rare cases when they become involved in a retrofit situation and need to try to explain the hazards and building code requirements to homeowners and are regarded as having come from some other planet.

Manufacturers and distributors of the high capacity exhaust equipment are affected. Every time one of these devices is installed without proper make-up air, a potential liability to the manufacturer and/or distributor is created. It may take a lawsuit by the family of someone killed by carbon monoxide drawn into a house by a downdraft cooktop to make the manufacturers and distributors aware of their liability.

Possible Regulatory Solutions

Appliance standards could deal with the interconnection issue by requiring the incorporation of interconnection features.

One measure would be to cover these devices under hazardous products regulations, which would require that depressurization avoidance be covered in installation instructions as a condition for being permitted to sell the product.

If the instructions that come with every capacity exhaust fan were to contain warnings about the hazards created by depressurization and the measures that could be taken to avoid those hazards, the information would be in the right place at the right time. ☼

It's Time to Sound the Alarm Regarding High Capacity Exhaust Devices, Paper presented at the Indoor Air 2002 Conference in Monterey, California by JC Haysom, Canadian Codes Centre, National Research Council of Canada, PH Huelman, University of Minnesota and D Fugler, Canada Mortgage and Housing Corporation.

Does Your Building Suck?

Most buildings do. They actually suck air in at the bottom and let it out at the upper portion. Stack, or chimney, action is the cause of many everyday problems whether in a two-storey house or a high rise.

Air leakage is important in controlling moisture flow through the building envelope. Buildings that suffer from uncontrolled air flow cost more money to heat and air condition. They are drafty, uncomfortable, have poorer indoor air quality and will deteriorate faster. Stack action is usually accompanied by two other effects, wind and ventilation, that alter the pressure within the building and cause uncontrolled air flow. None of this could take place without leaks, cracks, gaps and holes in the envelope of your building.

Airtight envelopes are the best solutions to stack effect, wind pressure and uncontrolled air change. If air cannot leave the top of a building, it will not enter the bottom.

In the commercial sector, specialist contractors are emerging. They focus on controlling air leakage by sealing gaps, cracks and holes with appropriate materials and systems. The aim is to repair or create a continuous air barrier. In residential construction, air sealing may be done by the builder or a subtrade - usually the insulation contractor.

Because of the hassles involved in accessing materials, one of the pioneers in building weatherization and air sealing, Canam Building Envelope Specialists in Mississauga, has created a marketing division that sells a range of air sealing products from weather-stripping to foam sealant products to blower doors. This is a one-stop shopping centre for professional weatherization materials. Their products are marketed under the Zerodraft name. To establish a North America wide dealer network, Canam is setting up a product dealership program under the Zerodraft name. ☼

For information
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Should Eco-friendly Homes be R-2000?

I am planning a new home to be built in the Vancouver area. Initially I was interested in an R-2000 home. Then as I did more research, I realized that there is much more than R-2000 that one can do as far as minimizing environmental impact. Even some professionals have said that R-2000 doesn't make sense in the mild coastal climate of Vancouver. My aim is to have a home that minimizes environmental impact. Should I still strive for an R-2000 house?

I am also considering geothermal for space and water heating. But with an energy-efficient R-2000 house, it will probably take much longer to break even with the high capital cost of geothermal. I have not found any references to R-2000 on the Internet in recent years. Does R–2000 certification make sense for an eco-friendly home in Vancouver?

Although R-2000 may not go as far as it could, and you may want to do more, it nevertheless is a big step in the direction you want to go. If all houses were built to the R-2000 standard, we as a society would be going in the right direction to address many of the serious climate change and resource issues we are facing, but too often deny.

An R-2000 house has a verifiable performance. It uses 40 - 50% less energy than a current code compliant house. This may not seem like a lot, but it is a significant step. You must also remember that the R-2000 Standard sets out minimum performance criteria that can be exceeded.

The value in R-2000 certification is the third-party verification that is done on every house to ensure that stringent criteria are met. As many builders have discovered to their dismay, what seems like simple upgrades to their procedures can be a challenge.

The growing interest in "green" design is a sign that the buying public is receptive and willing to make the right decisions. Unfortunately, there is also a lot of "green-wash" happening - lip service to green design with little of substance.

To set the record straight, the energy performance criteria of the R-2000 Standard are climate sensitive. The construction requirements for a design to meet the standard in northern Alberta would be significantly different if the same design was being built in Vancouver.

It is discouraging to hear that some people, even those sympathetic to environmental issues, are still saying that the R-2000 Standard is not suited to Vancouver's mild coastal climate. If we really want to see improvements in housing performance, all construction should be built at least to this standard.

Natural Resources Canada is revamping their own web site, but you can access current information on the R-2000 Standard (including the full standard document) at NRCan's Office of Energy Efficiency web site: *http://oee.nrcan.gc.ca/english/* or directly at *www.R-2000.ca*

I am also concerned that many people get enthused about geothermal technology as a "green" solution. They miss the point that an efficient system such as geothermal is only one part of the issue. Yes, geothermal heat pump systems are an efficient heat source. However, it is still important to reduce the energy load on the building by passive measures (higher levels of energy efficiency, passive solar design, etc.). Passive measures can go a long way to reduce the heat requirements of the house.

Only after all appropriate passive measures are taken, should you look at how best to provide the additional heat needed. The capacity will be much smaller. This is important because, unlike other heating systems, each ton of capacity (12,000 BTU) in a heat pump system has a significant incremental cost attached.

The real benefit of a geothermal system (and where the savings originate) is that for every one kWh of electricity, you get about three kWh back. However, a geothermal system still takes energy to run. ☼

R-2000

For information on the R-2000 Program, contact your local program office, or call 1-800-387-2000 www.R-2000.ca

Technical Research Committee News

Canadian Home Builders' Association

Public Consultation on the National Building Code

The National Building Code of Canada is now getting its final review by the provincial agencies responsible for building codes within their region. The formal public consultations will start later this year. With the new integrated code review procedures in place, all provinces are doing their reviews at the same time and on the same document. When the final version of the code is available, the only delays in adopting the new edition should be normal, bureaucratic administrative ones.

The new code will contain significant changes, as it will be written in new objective-based language. There will still be a portion of the document that will look somewhat similar to the present code, and contain the more familiar prescriptive and deemed-to-comply requirements. The code requirements should mean at most modest changes to specific requirements. CHBA will press for cost/benefit analyses of proposed changes in order to promote rational code decisions.

With this significant rewriting of the code, it will be important that all industry participants carefully review the proposed changes to make sure that no major errors have been inadvertently introduced. This should be a heads-up notice for local homebuilder association technical committee members (and anyone else with concerns) to make the effort to review all the proposed changes.

National Building Code of Canada 1995: Fourth Revisions and Errata

Revisions and errata to the current code document have been released. Most are minor technical changes, including changes to standards referenced in the code, and which have been updated.

Perhaps the most significant changes are an expanded Table A 9.10.3.1.A (Fire and Sound Resistance of Walls) and Table A 9.10.3.1.B (Fire and Sound Resistance of Floors, Ceilings and Roofs). These tables have been expanded and updated based on research that has been done in the past few years.

Registered code purchasers should have received a hard copy of the changes and errata. Copies can also be downloaded from the Codes Centre web site. *http://www.nrc.ca/irc*

Materials Emissions

Off-gassing and chemical emissions happen as newly manufactured or installed products set up and age. Those new house smells are a telltale indication of material off-gassing. Many of these emissions can have a health impact on occupants. That is why the R-2000 Standard promotes the use of materials that have lower emissions. The fewer the contaminants that are built in, the smaller the pollutant load of the house.

The challenge for builders and designers is to know what manufactured products are safe to use, especially with the wide range of engineered wood products, such as wood-I joists and OSB panels, in use today.

It has come to the attention of the TRC that some trainers are making blanket statements that all engineered systems made of OSB products contribute to excessive off-gassing. In fact, most are manufactured with phenol formaldehyde or isocyanate resins, and have negligible emissions once cured and shipped. When fresh, some products may emit some odours, but these are generally considered benign and can be sealed with a low-toxicity sealant. Concern about low-emissions products does not automatically prevent the use of engineered wood products.

For anyone building a home for people with special health needs, prudent use of any material is still required. One of the most valuable starting points is CMHC's book ***Building Materials for the Environmentally Hypersensitive***. This book describes most commonly used products and gives a brief description of the health issues associated with using them. ☼

The Technical Research Committee (TRC) is the industry's forum for the exchange of information on research and development in the housing sector.

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Silent Running

Creating Comfort Conditions by Design

by Mario Kani

It's a hot and muggy Toronto summer day. The house is cool and comfortable. The music from the stereo is clearly audible. The background noise from the low-level continuous 100% outdoor air ventilation is barely audible. Hardly the typical experience in a conventional air-conditioned house where noise and volumes of cold air are the norm. So what's the story?

The family occupying this house is enjoying the benefits of sustainable housing. The required elements of sustainable construction are a high-performance thermal envelope, reduced cooling load (solar control with southern overhang and selective glazing, as required), floor/ceiling radiant surface heating and cooling and additional low-flow ventilation air cooling and dehumidification.

Our firm, Allen Kani Associates, only designs green buildings with high R-value assemblies including windows. For glass on east and west orientations, spectrally selective glazing to reduce solar gains may be employed. The high-performance envelopes also feature airtight construction, which is complemented by controlled continuous low-speed ventilation with additional ventilation provided on occupancy demand. Our projects are increasingly employing thermal conditioning using radiant surfaces for both heating and cooling.

Standard forced-air heating and cooling have a number of drawbacks:

- Hot or cold blasts of air create discomfort
- High volume air recirculation is a source of significant noise and energy consumption – the single largest electrical load in gas-heated houses
- Recirculation compromises air quality by reintroducing contaminants to living spaces
- For ventilation compliance, the forced-air fan needs to operate continuously

The benefits of hydronic radiant space conditioning without air recirculation are:

- Even, slow changing space temperatures – no blasts of hot or cold air
- Properly designed hydronic systems use less than half of the annual energy of forced-air systems for pumping and air moving (outdoor air ventilation only)
- Zoning is easily achieved

The benefits of a high-performance envelope are:

- Low heating and cooling loads
- Heating and cooling surface temperatures are within 3° C (5° F) of room setpoint
- No condensation potential on interior surfaces with humidity control

In combination with latent load removal (dehumidification) by 100% outdoor air ventilation, the high performance envelope makes space cooling with a floor/ceiling radiant system viable. Because radiant surface cooling can only remove sensible gains (i.e., no condensation is allowed), a cooling/dehumidification coil is used in the ventilation supply airstream, fed by chilled water. The radiant cooling capacity, rather than the radiant heating capacity, is typically the critical distribution system design parameter.

For example, hydronic floor piping lengths are based on cooling output with, say, 18°C (65°F) water; heating output is then adjusted by regulating the supply water temperature.

The following design refinements reduce the cooling system costs:

- Provide chilled water (e.g., at 10° C, 50° F) to the coil for ventilation air sensible and latent cooling, then use the return water from the coil to supply the floors/ceilings
- Maintain a cooling setpoint at 22° C (71° F) on the hottest day, allowing the temperature to rise slowly to 25° C (77° F) and the cooling equipment capacity to be reduced to less than 50% of the conventional capacity at 25° C (77° F) due to mass effect. However, 24-hour dynamic modelling of the peak day is required

Our firm has designed several hydronic radiant heating/cooling systems recently (as well as hydronic heating/cooling convector systems). All projects are located in the Toronto area and have high-performance envelopes with special attention given to controlling cooling load.

Mario Kani, P.Eng., is partner in the sustainable technologies engineering, planning and consulting firm Allen Kani Associates, Toronto, Ontario.

An early radiant cooling project was a 180 m² (2000 sq.ft.) house which had such low heating and cooling loads that a heating coil and a cooling coil in the 100% outdoor air ventilation airstream supplied all thermal conditioning. The conditioned air was blown into floor cavities with open-web wood floor trusses, making the floors and ceilings radiant surfaces.

In summer, the heat recovery ventilator was switched to high speed when cooling was needed. Chilled water is created by circulating water from the rain cistern to the top of the metal roof at night and trickling it down-slope for return by the rain gutters. The film of water on the roof loses heat to the sky, lowering its temperature below the outdoor nighttime air temperature. The stored chilled water is then circulated via the cooling coil.

Ventilation supply is delivered to various living spaces without ducts by controlled floor or ceiling registers. Heating is provided by a contraflow masonry wood heater, which also supplements the solar hot water system in winter. Both space and domestic water heating are backed up with a high-efficiency potable water heater.

A more recent project is a 600 m² (6500 sq.ft.) custom home that uses four 60 m (200 ft) deep vertical hairpin ground water heat exchangers to dehumidify ventilation air via a chilled water coil. The heating and cooling was delivered by four zoned recirculating fancoils distributed throughout the house, located in ceiling cavities and sealed away from house air. As with the project above, the floor joists were open-web wood trusses. Heating and cooling coils heated or cooled the ceiling cavity airspace, which turned the ceiling and floor areas of the house into low-cost radiant panels.

Off-peak cooling was delivered directly from the ground heat exchangers but during the peak cooling season, chilled water was produced by a cooling-only heat pump. In winter the ground loops preheated ventilation air, thus frost proofing the energy recovery ventilator and chilling the ground before the next cooling season. Space and potable water heating was provided by an evacuated tube solar array backed up by a high-efficiency, low NO_x gas boiler.

We have used the same design principles in larger buildings. One was an 1850 m² (20,000 sq.ft.) retreat centre with offices and meeting rooms on the first floor. In this project piping was used for the heating/cooling system. The radiant floor tubing was embedded in a 50-mm (2") cement toping over 200 mm (8") hollow-core precast concrete floors.

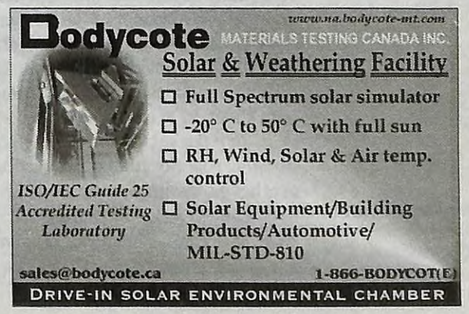
The main floor meeting rooms have radiant output from both floor and ceiling to deal with the higher occupancy. The second-storey residential occupancy has only a floor radiant component. The building has no cooling plant other than a 50-m (165 ft.) deep extraction well (which also supplies potable water) and a second similar well receiving the cooling return water. In winter, the well water preheats the outdoor air to frost-proof the energy recovery ventilators.

Our latest project with in-floor radiant heating and cooling and ventilation air dehumidification is a 440-bed university residence. The skeptical staff of a large mechanical engineering firm who had never even designed a radiant heating/cooling system, became promoters of the system.

Some pointers on radiant heating/cooling systems:

- Information for calculating radiant performance can be found in the chapter on Panel Heating and Cooling in the ASHRAE HVAC and Equipment Handbook or can be requested from the major in-floor radiant piping suppliers
- Most of the output for cooling is provided by the ceiling. By insulating the floor with floor finishes, e.g., natural linoleum with cork underlay, both heating and cooling will be ceiling dominant, allowing zone control with the indoor thermostat controlling the loop above the ceiling.

We find that these systems cost-effectively provide superior comfort and indoor air quality as well as significant energy savings and environmental benefits. ☼



Energy Answers

Rob Dumont

How big a central air conditioner would I need for a new 1200 square foot (112 square metre) house located in Calgary?

That is the wrong question to ask.

Central air conditioning in houses in most parts of Canada is needed only as a result of poor building design and operation. Canada is not Arizona or Florida. Although a few areas have periods of hot and humid summer weather, no parts of our country approach the sustained hot weather that the Southern US experiences. Yet the advertising people would have us believe that no Canadian home is complete without air conditioning. Air conditioners are noisy and relatively expensive energy users that often create indoor air quality problems because of poor handling of the moisture that accumulates on the cold coils. Air conditioners should be unnecessary in a well-designed and operated house almost anywhere in Canada.

What can be done to eliminate the need for air conditioning? Here are Dumont's directives for defeating the need for providing air conditioning in residences:

1. Orient your house so that east and west facing windows are minimized. In most houses unshaded windows are the single largest source of unwanted heat gain. East and West facing windows are the worst, as the sun's rays are often at almost 90 degrees to the windows on late summer afternoons. Use overhangs with south facing windows to avoid direct sun hitting them in the summer. North facing windows generally receive little direct solar radiation, except for a short period around June 21.

Every square metre of a west facing unshaded window, for example, will put about 600 watts (2000 Btu/hour) of undesired heat into your house on a sunny day. A west facing double glazed patio door with an area of four square metres (43 square feet) will dump 2400 watts of heat (8000 Btu/hour) into a house in the late afternoon in summer. By comparison, small window air conditioners put out only about 5000 Btu/hour.

2. Stop the solar heat gain before it enters the window. Exterior shades, exterior venetian blinds, overhangs, awnings, exterior screens, trees, your neighbour's house – all of these can serve to reduce solar heat gain. Remember that horizontal overhangs don't work very well with east or west facing windows. See directive number 1.

3. Stop the solar gain after it passes through the window. Most west facing apartment buildings will have at least one suite with a good portion of the windows covered with aluminum foil. Aluminum is a very good reflector of heat. Other measures such as reflective film, interior shades, closed venetian blinds all help to reduce undesirable solar gains, but the best place to interrupt the solar gain is outside the window. See directive number 2.

4. Use a light-coloured roof and light-coloured exterior walls. In addition to lasting longer, light-coloured roofs will have a lower surface temperature. The sun beating on a dark coloured roof or wall on a sunny day can raise the roof temperature by as much as 40° C (72° F) on a windless day. You rarely see black cars in the tropics; many large aircraft have the top part of the fuselage painted white for the same reason. White is cool! Many Mediterranean village dwellers make a point of frequently whitewashing the exterior walls of houses to limit solar gain.

5. Good attic insulation is a great way of limiting solar heat gain into the top part of your house. A 1200 square foot attic with R60 insulation will pass only about 1400 Btu/hr into the house even if the attic is 70° F (48° C) warmer than the top floor rooms of the house.

6. Increase the mass level in your house. A heavier house will not heat up as quickly as a lighter house on a hot day. An inexpensive way to get more mass into a wood frame house is to pack scrap gypsum board into the walls and ceiling cavities. If you have a concrete basement in the house, consider insulating the concrete on the outside to take advantage of the thermal mass. The concrete basement floor should also be insulated as well. It is a great way to avoid that musty basement smell and ensure that the surface temperature is never below the dew point. Concrete topping on wood floors is also effective.

7. Choose energy efficient appliances and lights. That "free" old refrigerator in your new house likely will use two to three times as much energy as a new refrigerator. All the energy used by lights and appliances (excluding outside vented clothes dryers and exterior use) will show up as a heat load on your house. Most houses here in Saskatchewan average about 23 kilowatt-hours per day for electrical usage for lights and appliances. That amounts to an average internal heat gain of 3270 Btu/hour. Wise selection of lights and appliances, and careful use of appliances could reduce that amount by one-half to two-thirds without denying you the normal comforts of home. As my mother often told me, "If you don't make a mess, you don't have to clean it up." The saying works as well for heat gain as for clutter.

8. Use operable windows to provide free cooling. Almost every location in Canada will have evening temperatures that fall below 20° C (68° F). Here in Saskatchewan there was not one night last summer when the outdoor temperature did not fall below 19° C, even though the air temperature in the late afternoon reached +39° C. By opening windows once the outdoor temperature drops below room temperature, you can reap free cooling. Casement (side-hinged) windows are among the best at catching prevailing winds. In the morning, close the windows to retain the "coolth" stored in the building materials.

If, and only if, the above passive measures do not keep your house in the comfort zone, choose the following low impact active devices before you consider air conditioning.

9. Use a ceiling, table, or floor mounted fan to increase the air motion in the rooms you frequent. Your normal skin temperature is about 86° F (30° C). Increasing the air flow over your skin will give a cooling effect even if the air temperature is as high as 30° C. Many residents of tropical countries use this technique to keep conditions bearable.

10. Use a window-mounted fan to induce air flow from the outdoors into the rooms of your house once the outdoor temperature has cooled off in the evening. Several companies, including Honeywell, Holmes and Duracraft, now make reversible fans suitable for mounting in windows. Some even come with an air filter to reduce the entry of dust and pollen, and some of the fans come with thermostats.

11. Use a whole house fan to rapidly change the air in your house. My aunt living in Detroit uses this technique to cool her house down in the evenings. The whole house fan is usually mounted in the ceiling of the top floor of the house and exhausts house air into the attic once the outdoor temperature has fallen. The fan moves a lot air, and serves two purposes – it brings cooler air into the house through open windows and also vents the attic to lower the temperature up there. Be warned that whole house fans are usually quite noisy.

12. Consider the use of an evaporative cooler. Convair is one company that makes a portable unit. Every pound of water that you evaporate can absorb about 1000 BTU. I would not recommend the units in a coastal area, as they will raise the relative humidity in your house too much.

13. If you have honestly used all twelve of the above techniques, and your house is still not comfortable, buy a small window air conditioner.

In summary, to keep a comfortable home in warm weather, first control the heat gain sources, use thermal mass, ventilation, evaporative cooling and then, and only then, use spot air conditioning. ☼

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Fire and Acoustics Research on Load-Bearing Steel Stud Walls

IRC's Fire Risk Management Program, working with nine industry partners, conducted 14 full-scale standard tests to study the effect of various parameters on the fire resistance of load-bearing steel-stud wall assemblies. The test parameters included:

- the spacing of steel studs; the number of stud rows (i.e., single- versus double-stud walls);
- the number of gypsum board layers (i.e., one versus two layers of protection);
- the use of cross-bracing; the replacement of one layer of gypsum board with an oriented strand board (OSB) shear membrane;
- the use of resilient metal channels to support the gypsum board; and
- the type of insulation used in the wall cavity.

Each full-scale assembly was exposed to a "standard fire" in a propane-fired vertical test furnace until it failed in one of three ways: structural failure; exceeding a specified temperature; flame or gas penetration. In all cases, the wall assemblies failed structurally. The unexposed surface temperature at this time was below the temperature criteria for failure.

Two of the factors that most affected the fire performance were the stud spacing and the type of insulation. For stud spacing, the results indicated that steel-stud wall systems with stud spacing of 610 mm provided higher fire resistance (74 minutes) than those systems with stud spacing of 406 mm (59 minutes). This difference in fire-resistance performance is explained by the fact that the wall assembly with wider spacing has fewer studs than the assembly with closer spacing and thus carries a smaller load. In accordance with the test protocol, the load is based on the number of studs – fewer studs mean a smaller overall load. In the course of the fire tests for both assemblies, the load shifted to the end studs, which were less exposed to fire than the inner studs. But since the end studs must carry a greater load for the wall assembly with closer spacing, this assembly fails more quickly than the assembly with wider spacing.

The research results indicated that uninsulated wall assemblies provide a higher fire resistance than insulated ones. There are two reasons for this:

1. The insulation keeps the gypsum board facing the fire hot, causing it to crack and fail more quickly than in an empty cavity. Once it has failed, the insulation and studs are exposed to the heat of the fire.
2. The insulation allows the heat to build up and become trapped in the cavity, thushastening the structural failure of the studs.

The results also showed that there is considerable variation in the effects of different types of insulation on fire resistance. Glass fibre insulation produced a fire resistance of 56 minutes, rock fibre 59 minutes and cellulose 71 minutes. By contrast, the fire resistance of an uninsulated assembly was 77 minutes.

Sound Performance Results

Since sound ratings for party walls are needed in conjunction with fire resistance ratings, IRC's Acoustics Group, in a related project, studied the sound transmission characteristics of steel-stud wall assemblies. Using wall assemblies similar to those tested for fire resistance, the acoustics researchers found that the method of framing had some effect on sound transmission. Each wall assembly tested had one row of load-bearing studs and used horizontal resilient metal channels to support the gypsum board covering on one side.

The project also focused on the effect of shear bracing, such as might be used in earthquake-prone areas. It was found that steel framing elements, such as blocking or cross-bracing straps, had little effect on sound transmission. However, adding an oriented strand board layer between the studs and the attached gypsum board improved the sound transmission class (STC) as a result of the increased surface weight. (The higher the STC, the greater the noise reduction.)

The single most important parameter in sound transmission control was the weight of the gypsum board surface layers. Typically, the STC improved by about 5 when the weight of the gypsum board on either side of the wall was doubled. The researchers demonstrated this improvement by both changing the number of gypsum board layers on the assembly and changing their weight.

Other ways to improve the STC include: filling the inner-stud cavities with fibrous insulation, allowing for greater spacing between the resilient channels, and using studs made of thinner steel. In fact, compared to cases with empty cavities, the STC improved by 8 to 10 when stud cavities were completely filled with insulation, although the type of insulation had only a slight influence.

Although the fire and acoustics research showed that uninsulated assemblies performed better in terms of fire resistance while insulated assemblies were superior acoustically, it also identified a wide variety of constructions that provide both satisfactory fire resistance and noise control in terms of meeting National Building Code (NBC) requirements. As well, by studying sound and fire together, some constructions that don't meet the intent of the code were also identified.

A group of industry partners are drafting a proposed addition to the Appendix to Part 9 of the NBC, which could result in many more entries for steel-stud wall assemblies in the table of fire-resistance ratings (FRR) and sound transmission class (STC) ratings for walls. These fire and sound ratings make it possible for designers and builders to assess an assembly's compliance with code requirements. ☼

The partners for the project were: Canadian Home Builders Association, Canadian Sheet Steel Building Institute, Canadian Steel Construction Council, Canadian Wood Council, Cellulose Insulation Manufacturers Association of Canada, Fortinek Canada Corporation, Gypsum Manufacturers of Canada, Owens-Corning Canada, and Roxul Inc.

For more information on the acoustics aspects of the study, please access a report in pdf format on the following IRC site:
http://www.nrc.ca/irc/fulltext/ir832/.

This article was adapted from two articles appearing in the June 2002 edition of IRC's quarterly newsletter, Construction Innovation. Questions about the fire-resistance of wall assemblies can be directed to Dr. Venkatesh Kodur at (613) 993-9729, fax (613) 954-0483, or by e-mail at *venkatesh.kodur@nrc.ca*

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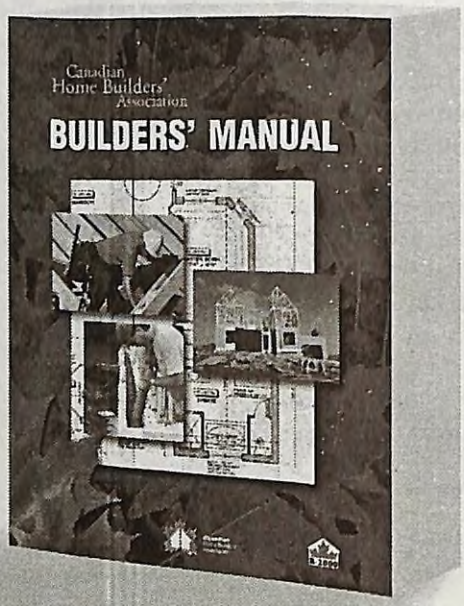

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